



IB MYP YEAR 5

YEAR 10 Mathematics

Assessment #4

AP, GP, LOGARITHM, EXPONENTIAL, BEST FIT

Name: Elizabeth Kot ( 10 Trust )

Teacher: Ms. Li, Mr. So & Mr. Wong

Date of task: Friday, 22<sup>nd</sup> February, 2013

Time allowed: 2 lessons

Student's Performance in Different Criterion			
<b>A</b>	3	<b>D</b>	2

**INSTRUCTIONS:**

Read the **rubric** carefully because that is how you will be graded.

Read the instructions for all questions carefully.

Show all work, steps and proper units.

Write your answers on the lined paper/graph paper provided.

**GDCs** are allowed.

Ask the teacher for scrap paper, but any work on the scrap paper will **NOT** be marked.

Allowed to use calculators.

Allowed to use **non-electronic dictionary**.

Criterion A: KNOWLEDGE AND UNDERSTANDING

Achievement level	Task Specific Rubric	IBO Published Descriptor	Student's self-evaluation
<b>0</b>	The student does not reach a standard described by any of the descriptors given below.	The student does not reach a standard described by any of the descriptors given below.	
<b>1–2 Simple</b>	The student manipulates the data correctly, but <b>without</b> reaching a full model.	The student <b>generally</b> makes appropriate deductions when solving <b>simple</b> problems in <b>familiar</b> contexts.	
<b>3–4 Complex</b>	The student is able to come up with a <b>basic</b> model and make simple <b>predictions</b> based on the model.	The student <b>generally</b> makes appropriate deductions when solving <b>more complex</b> problems in <b>familiar</b> contexts.	<b>Teacher's Final Grade</b>
<b>5–6 Challenging</b>	The student is able to come up with an <b>appropriate</b> model and <b>explain</b> the processes by which the model was created.	The student <b>generally</b> makes <b>appropriate</b> deductions when solving <b>challenging</b> problems in a <b>variety</b> of <b>familiar</b> contexts.	
<b>7–8 Unfamiliar</b>	The student comes up with an appropriate model which fits the initial data and then comes up with an <b>unfamiliar model</b> which also fits the <b>new data</b> .	The student <b>consistently</b> makes <b>appropriate</b> deductions when solving <b>challenging</b> problems in a <b>variety</b> of contexts including <b>unfamiliar</b> situations.	
			<b>(0–8)</b>

Criterion D: REFLECTIONS & EVALUATIONS

Achievement level	Task Specific Rubric	IBO Published Descriptor	Student's self-evaluation
<b>0</b>	The student does not submit a poster. Or, the students submit work with unacceptable quality.	The student does not reach a standard described by any of the descriptors given below.	
<b>1–2 Real Life</b>	Student talks about real life changes in Hong Kong which cause changes in the growth of rubbish.	The student <b>attempts to explain</b> whether his or her results make sense in the context of the problem. The student <b>attempts to describe</b> the importance of his or her findings in connection to real life.	
<b>3–4 Degree of Accuracy</b>	In considering the percentage error, student can justify which model is more accurate in predicting waste in 2009–11. Percentage error must be attempted to achieve a level 4.	The student <b>correctly but briefly explains</b> whether his or her results make sense in the context of the problem. The student <b>describes the importance</b> of his or her findings in connection to real life where appropriate. The student <b>attempts to justify</b> the degree of accuracy of his or her results where appropriate.	<b>Teacher's Final Grade</b>
<b>5–6 Improvements</b>	Student thinks critically about units and the improvements of the second model from the first model. Percentage error is used to catch mistakes if any.	The student <b>critically explains</b> whether his or her results make sense in the context of the problem. The student provides a <b>detailed explanation</b> of the importance of his or her findings in connection to real life. The student <b>justifies the degree of accuracy</b> of his or her results where appropriate. The student suggests improvements to his or her method where appropriate.	
			<b>(0–6)</b>

## HOW DOES TRASH IN THE TKO LANDFILL GROW?

The government proposes expanding the Tsang Kwan O landfill (opened at the start of 2000). You have gathered the following data:

	$T_1$	$T_2$	$T_3$	$T_4$	$T_5$	$T_6$	$T_7$	$T_8$
Year	2001	2002	2003	2004	2005	2006	2007	2008
$m^3/day$	1,749	1,903	2,040	2,274	2,549	2,645	2,811	2,940

Table 1: Commercial & Industrial Solid Waste in Hong Kong<sup>1</sup>

You suspect there is a predictable pattern in the growth of waste dumped at the site.

1. **Find** a mathematical model that appropriately describes the growth. **Explain** the processes by which the model is created?

G.P.

$T_n = 1749 + (n-1)170$

Year	2001	2002	2003	2004	2005	2006	2007	2008	Avg
$d$	/	154	137	234	275	96	166	129	170
$T_n = a + (n-1)d$	0	1919	2089	2259	2429	2599	2749	2939	
$r$	/	1.09	1.07	1.11	1.12	1.04	1.06	1.05	1.08
$T_n = ar^{n-1}$	0	1888.92	2040.03	2203.24	2379.5				

By looking at the table above, using A.P involves a lot of decimal places, which has greater chance in calculation error, so G.P. is adapted to be used.

What do you mean?

<sup>1</sup> The Government of the Hong Kong Special Administrative Region, "Monitoring of Solid Waste in Hong Kong," Disposal of Solid Waste at Landfills: Commercial & Industrial Waste (plate 2.3), 2000-2010, viewed January 13, 2013, [http://www.wastereduction.gov.hk/en\\_html/assistancewizard/waste\\_red\\_sat.htm](http://www.wastereduction.gov.hk/en_html/assistancewizard/waste_red_sat.htm)



2. By using the model you acquired, predict which year the amount of waste will be **more than 3200 m<sup>3</sup>/day**.

$$1749 + (n-1)170 > 3200$$

$$(n-1)170 > 3200 - 1749$$

$$170n - 170 > 1451$$

$$170n > 1451 + 170$$

$$n > \frac{1621}{170}$$

$$n > 9.5 \quad \checkmark \quad \approx 10$$

Therefore, I can predict that by 10 years, the ~~amount~~ of waste will be more than 3200 m<sup>3</sup>/day.

3. Predict the amount of waste OVER THE ENTIRE YEAR dumped in **2009**, **2010** and **2011** based on your model.

2009:

$$T_9 = 2009.$$

$$T_n \times 365.$$

$$T_9 = 1749 + (9-1)170$$

$$= 3109 \times 365$$

$$= 1134785 \text{ m}^3/\text{day}$$

2010:

$$T_{10} = 1749 + (10-1)170$$

$$= 3279 \times 365$$

$$= 1196835 \text{ m}^3/\text{day}$$

$$S_n = \frac{n}{2}(a + (n-1)d)$$

2011:

$$T_{11} = 1749 + (11-1) \cdot 170$$

$$= 3449 \times 365$$

$$= 1258885 \text{ m}^3/\text{day}$$

4. The actual amount of waste dumped in 2009, 2010 and 2011 were 1,089,160 m<sup>3</sup>/year, 1,087,335 m<sup>3</sup>/year and 1,103,395 m<sup>3</sup>/year. Using **percentage errors** or any other valid method, come up with the degree of accuracy of your predictions in question 3. **How accurate was your model?**

2009:  $\frac{\text{new} - \text{old}}{\text{old}} \times 100\%$

$$\frac{1089160 - 1134785}{1134785} \times 100\%$$
$$= -4\%$$

2010:

$$\frac{1087335 - 1196835}{1196835} \times 100\%$$
$$= -9\%$$

2011:

$$\frac{1103395 - 1258885}{1258885} \times 100\%$$
$$= -12\%$$

Since the percentage error is not really high, so I assume that my model was accurate

5. What changes in **Hong Kong in 2009** could account for any change in the pattern of waste growth?

Since the amount of waste produced per day in 2009 is more than 2010, so it affects the pattern of waste growth because when we calculate through terms, we expect each year has similar amount of waste increase (d). So when the amount of increase in the real situation didn't increase as expected, then the calculated pattern of waste growth will be affected.

6. Use your calculator to come up with a **new** model (not linear or exponential). Write down the model below.

$$y = a + b \times \ln x \quad (\text{logarithmic})$$

$$a = 1674.45035.$$

$$b = 667.056488.$$



old.

$$y = ax + b$$

$$a = 169.878787 \approx 170.$$

$$b = 1747.6666 \approx 1748.$$

$$a \times e^{bx}.$$

$$a = 1848.33028$$

$$b = 0.06458949$$

7. Use **both** your **original** and **new** models to predict the amount of waste generated in 2013.

**Original:**

$$y = ax + b$$

$$y = 170(13-1) + 1748$$

$$= 3788$$

$$3788 \times 365 = 1382620$$

**New:**

$$y = a + b \times \ln x$$

$$y = 1674.45035 + 667.056488 \times \ln(13)$$

$$= 3385.41646$$

$$3385.41646$$

$$3385.41646 \times 365$$

$$= 1235671.008$$

8. How do the results in Q7 compare? Explain the differences in your results. Why are they important?

The difference between the results in Q7 is 40,3. The original model uses the equation of linear graph and the new one uses the logarithmic graph. The difference between the graphs is that log graph touches x-axis only, however, linear graph is a straight and can touch both axis (x and y-axis). The area where the line of the types of graphs the can touch on the axis (x and y-axis) might have an affect on the calculated results. It is important because only by choosing the right graph can calculate accurate and reliable data.

**THE END**

